

out of the older flows, while *coulées* were poured down the excavated hollows. In these respects the history of this late North American volcanic action recalls the succession of events so long ago and so admirably described by Mr. Poulett Scrope as traceable among the volcanic masses of Central France.

The mines now in operation, as well as indications of probable positions for new ones, are carefully noted in the Report. The geologists, indeed, have constantly had before them the consciousness that the future development of these territories would not be helped so much by their making out all geological details at present as by their ascertaining what practicable places could be found for the establishment of mining industry. At the same time, they deserve great credit for keeping the thoroughly scientific character of their duty so conspicuous in their reports; for undoubtedly the only way to make an exploration which shall be of real value as a guide in mining operations is to do it in the strictest sense geologically. With the area and relations of the different rock-formations mapped out for him, the mining prospector may save much time and money by learning what tracts to avoid as well as which to explore.

Each of the geologists in command of a division under Dr. Hayden furnishes a report, which appears in the present volume. These are remarkably well done, that of Mr. Marvin being specially interesting from the variety of phenomena with which he had to deal and the clearness with which he tells his story. Besides the geological reports, Prof. Lesquereux supplies one of great value on the Lignitic formation and its fossil flora, in which he enters anew into the vexed question of the true age of that formation. As the result of his long study of its large and well-marked flora, he concludes that the formation is of Tertiary date, a conclusion which agrees also with that to which Dr. Hayden has been led. A large list of new species of fossil plants from the Lignitic strata is described by him in his report. Under the head of Zoology are gathered a number of communications on insects, crustacea, mollusca, and other invertebrata, collected or observed during the progress of the Survey. The part devoted to Geography and Topography contains the reports of the geographer and his colleagues on the system of triangulation employed, the heights of various places, the practicable routes, and other matters. The book is well printed and well illustrated. It deserves the heartiest commendations both for the Government which supports such good work and for the men by whom it is practically done.

ARCH. GEIKIE

ALIX ON THE LOCOMOTION OF BIRDS

Essai sur l'Appareil Locomoteur des Oiseaux. By Edmond Alix, M.D. (Paris: G. Masson.)

THIS considerable volume, the first independent work of any pretensions on the osteology and myology of birds, is a valuable addition both to zoological and to ornithological literature. As far as the latter is concerned it would have been more distinctly useful if the author had been better acquainted practically with birds' skins, as well as with the binomial nomenclature and the importance of specific distinctions. If he had, such a sentence as the following

would have been modified in a manner which would have made it of greater value to future investigators, at the same time that the precision would have added weight to the points brought forward. We are told with reference to the accessory femoro-caudal muscle that "this fasciculus, represented in the Cormorant by an aponeurotic band, is found uncomplicated in the Grebe, Flamingo, Heron, Bustard, and Secretary Bird," in which remark the fact that what are there termed Grebe, Bustard, &c., are general terms, seems to be entirely ignored; as is therefore the possibility of there being structural differences among the members of the included groups. It may even be mentioned that respecting the very point referred to in the above quotation, the statement therein made does not generally apply, being correct as far as the Little Grebe (*Podiceps minor*) and the Common Heron (*Ardea cinerea*) are concerned, but being inaccurate when said of the Eared Grebe (*Podiceps cristatus*) and the Giant Heron (*Ardea goliath*). Most works on the anatomy of birds suffer from the same imperfection; the importance of specific and even generic distinctions being generally disregarded, by all but pure ornithologists.

The work is divided into three sections—the three in which the consideration of the locomotive apparatus of birds most naturally falls; namely, the consideration of birds firstly as vertebrated animals (zoologically); secondly, as a special organised type (anatomically); and thirdly, as flying animals (physiologically). An excellent *résumé* of previous investigations on the several subjects prefaces each section, in which due credit is on nearly all occasions given to foreign workers.

Under the first heading, following the teaching of De Blainville and Gratiolet, Dr. Alix describes the typical skull on the hypothesis of its vertebral origin; of the fourth or nasal vertebra, considering the perpendicular plate of the ethmoidal as the centrum, the lateral masses of that bone as the laminae, and the nasals as the spinous element.

In the treatment of the osteology of birds, most of the important subjects which have of late attracted most considerable attention are fully discussed. We are rather surprised to find no reference to the point so forcibly put forward by Prof. Parker, and laid stress on by Prof. Huxley, with regard to the anchylosis of the palatine bones with the vomer in the Tinamous. The vomer as a separate bone is also rather neglected. As to the light thrown by a study of the skull on the classification of birds, we read that "the examination of the head of birds confirms the major divisions established originally from a consideration of the beak and the feet. It proves that Raptores, Passeres, Gallinae, &c., exist in reality: but it also renders it evident that there are divisions beyond these not capable of being included among these primary forms. For instance, the Parrots form a well-marked group of themselves . . . the Raptores Nocturnæ are clearly distinct from the Raptores Diurnæ, the Pigeons can in no way be confounded either with the Passeres or with the Fowls." As to the sternum, "the results arrived at by De Blainville and confirmed by subsequent authors (are said to) prove that Cuvier has narrowed the question too much in affirming that the indications afforded by the sternum cannot serve for more than generic distinctions. But it must be admitted that, with the exception of the cha-

racters indicated by the presence or absence of the carina, it is almost impossible to recognise in the sternum any of those distinguishing features which may be stated in a single word, or may be incorporated as a definition in any tabular arrangement. The sternums of most birds, even those which are most peculiar, must be considered in their entirety, and a complete description is necessary for their differentiation." We would feel disposed to go even further than this, and to say that in the sternum there are characters from which, with a little extraneous assistance, more considerable generalisations may be arrived at. It is true that in the passerine *Pteroptochus* the posterior margin is doubly notched on either side, but in how different a manner from that in the piciform birds and owls! What more than the sternum proves the closeness of the relationship between the Toucans, Woodpeckers, and Capitoes, also between the Swifts and the Humming Birds, as well as the small kinship between the gallinaceous birds and the Sand Grouse? On the other hand, the sternum does not aid us much in the determination of more distant relationships, such as those of families one to the other. From it alone we should not feel justified in placing the Tinamous near the Apteryx, nor the Stormy Petrels near the Fulmars.

In the *Bulletin de la Société Philomathique* and in the *Journal de Zoologie* Dr. Alix has published his dissections of the Rhea and of a Tinamou (*Nothura major*). His myological investigations are based on the descriptions given by Vic d'Azyr and Meckel. Following the latter of these, he mentions that in the Cormorant the ambiens muscle (*accessoire iliaque du fléchisseur perforé*) is absent, which is decidedly not the case in the common species (*Phalacrocorax carbo*). With reference to this bird, the accessory femoro-caudal is said to be represented by an aponeurotic band, which we have failed to detect; and the same remark applies to the muscle itself in the Heron (*Ardea cinerea*), in which it is also said to be developed; from which we may infer that the author has evidently not clearly recognised the characters which distinguish this fleshy fasciculus from the obturator externus (*carré*); and that such is the case is further proved by his statement that the latter named muscle is enormous in the ostrich, in which it is in reality very small, being almost hidden by the former.

The flexor tendons of the toes are specially dwelt on. The flexor perforatus digitorum is shown to present peculiarities sufficiently important to deserve special names. This muscle in birds is not a single one, but is formed of a superficial and a deep group; the latter having two separate origins, an internal and an external, of which the relative proportionate bulks vary. Those birds in which the outer head is the larger are termed *ectomyens*; those with a larger internal head, *entomyens*; and those with equal heads, *homœomyens*. "The palimpeds, the longirostral and pressirostral Waders, the Flamingoes, the Storks, the Tinamous, the struthious birds and the Parrots, are entomyen; the Herons, the Rails, the gallinæ, Pigeons and passerines, are homœomyen; whilst the diurnal and nocturnal birds of prey are ectomyen." The deep flexors are said not to offer such remarkable differences as those just referred to, but as none of their most striking peculiarities are mentioned, we presume that the author is unacquainted with them. The long flexor tendon to the

hind toe, we are told, is absent in the swan; it may be so in *Cygnus olor*, such is certainly not the case in *C. nigricollis*.

The last section of the work is almost entirely devoted to the flight of birds, this subject being viewed from a theoretical standpoint only. It is demonstrated in a fairly conclusive manner that the assumption of Borelli, in which the wing is considered to strike directly downwards and to turn backwards simply on account of the yieldingness of its posterior margin, is insufficient to explain the different movements observed; at the same time that it is opposed to the results arrived at from a study of the shape of the articular surfaces of the shoulder, and the arrangement of the fibres of the muscles acting on that joint. This, we think, is the tendency of modern investigation, notwithstanding the support, by M. Marey, of the opposite view. The results of the elaborate investigations of this latter able physiologist are as easily explained upon the one assumption as the other, perhaps better on the anti-Borellian theory, which no doubt is not required to account for the movements of the wings in the much less intricate problem of insect flight.

The following are Dr. Alix's propositions on this subject:—"First. The wing in the down-stroke begins by moving forward to attain its basis of support; after which it strikes briskly from above downwards, and at the same time from before backwards, as a result of which the bird is projected forwards. Second. At the moment at which the wing commences to descend, its lower surface looks forwards; but as it descends, this surface gradually turns to look directly downwards, and ultimately more and more backwards. Third. During the ascent of the wing, it moves upward and forward, its inferior surface at the same time looking forward." The nearly complete agreement of these observations with the results of M. Marey's previously published experiments is worthy of note, considering the differences in the starting-points of the two authors. The question of avian locomotion, as it now stands, is therefore not so much as to what are the positions of the wing during the different parts of the stroke, but as to whether the variations in the direction of its plane depend for their origin on the movements imparted to the humerus by the muscles acting on the shoulder, or on the influence of the resisting air upon a vertically moving plane which is more yielding behind than in front. This question requires further elucidation, though, as we have just remarked, we think, with Dr. Alix, that the balance of evidence is considerably in favour of the former view.

In conclusion, we strongly recommend this complete and able exposition of the locomotor apparatus of birds to all students both of physiology as well as of zoology.

"THE ABODE OF SNOW"

The Abode of Snow. Observations on a Journey from Chinese Tibet to the Indian Caucasus, through the upper valleys of the Himalayas. By Andrew Wilson. (Edinburgh and London: W. Blackwood and Co., 1875.)

LAST week we noticed Mr. Drew's almost exhaustive work on Jummo and Kashmir; Mr. Wilson's work is to a large extent concerned with the same region, as